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MECHANICAL-PROPERTY DATA
7039 ALUMINUM

Plate (T6151 Condition)

Issued by

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Research and Technology Division
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

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Prepared by

Battelle Memorial Institute
Columbus Laboratories
Columbus, Ohio 43201

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This data sheet was prepared by Battelle Memorial Institute under Contract AF 33(615)-2494. The contract was initiated under Project No. 7381, "Materials Application", Task No. 738106, "Design Information Development". The major objectives of this program are to evaluate newly developed structural materials of potential Air Force weapons-system interest and then to provide data-sheet-type presentations of mechanical data. The program was assigned to the Structural Materials Engineering Division at Battelle under the supervision of Mr. Walter S. Hyler. Project engineer was Mr. Omar Deel. The program was administered under the direction of the Air Force Materials Laboratory, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio, by Mr. Marvin Knight, project engineer.

Notices

7039 Aluminum

Alloy 7039 is a recently developed heat-treatable, weldable aluminum alloy. The alloy was developed primarily for armor-plate applications; however, its high strength, weldability, formability, toughness, and corrosion resistance suggest it is suitable for cryogenic applications, missiles, and other structural applications where these properties are of importance.

Alloy 7039 is commercially available in plate, forgings, and extrusions. Sheet is available upon special inquiry.

7039 ALUMINUM DATA[a]

Condition: -T6151
Thickness: 1.00-inch plate

Properties	Temperature, F				
	-320	-105	RT	300	500
Tensile					
F_{tu} (longitudinal), ksi	79.5	65.5	58.8	41.9	--
F_{tu} (transverse), ksi	78.3	65.1	58.2	41.7	--
F_{ty} (longitudinal), ksi	58.9	51.8	48.6	41.0	--
F_{ty} (transverse), ksi	58.1	51.3	47.9	40.4	--
e_t (longitudinal), percent in 2 in.	20.3	16	17	33	--
e_t (transverse), percent in 2 in.	18	17	16	31	--
RA (longitudinal), percent	26.9	31.7	38.8	62.2	--
RA (transverse), percent	24.9	30.3	35.8	55.8	--
E_t (longitudinal), 10^6 psi	11.7	11.0	10.2	9.5	--
E_t (transverse), 10^6 psi	11.8	11.3	10.3	9.5	--
Compression					
F_{cy} (longitudinal), ksi	56.9	50.4	47.5	41.4	--
F_{cy} (transverse), ksi	60.5	53.1	50.6	42.6	--
E_c (longitudinal), 10^6 psi	11.1	10.4	11.1	9.3	--
E_c (transverse), 10^6 psi	12.1	10.5	10.3	9.9	--
Impact (V-notch Charpy)					
(Longitudinal), ft-lb	9.2	U[b]	12.7	16.2	--
(Transverse), ft-lb	6.0	U	9.0	10.8	--
Fracture Toughness[c], K_{Ic}, ksi$\sqrt{in.}$	U	U	48.2	(c)	--

(6 pp) (5 fig.) (tbls..) ( ) ref.)

7039 ALUMINUM DATA (Continued)

Properties	Temperature, F -320	-105	RT	300	500
Shear(d)					
F_{su} (longitudinal), ksi	U	U	33.7	U	--
F_{su} (transverse), ksi	U	U	31.9	U	--
Axial Fatigue (Transverse)					
Unnotched, R = 0.1(e)					
10^3 cycles, ksi	90	U	61	52	--
10^5 cycles, ksi	71	U	48	46	--
10^7 cycles, ksi	56	U	38	38	--
Notched, K_t = 3.0(e), R = 0.1					
10^3 cycles, ksi	73	U	58	53	--
10^5 cycles, ksi	34	U	17.5	20	--
10^7 cycles, ksi	18	U	10	11	--
Creep (Transverse)					
0.5% elongation 100 hr, ksi	--	--	NA(b)	24	3.8
0.5% elongation 1000 hr, ksi	--	--	NA	19	2.7
Stress Rupture (Transverse)					
Rupture 100 hr, ksi	--	--	NA	28	5.4
Rupture 1000 hr, ksi	--	--	NA	21	3.7
Stress Corrosion					
80% F_{ty}, 1000 hr max.	--	--	No cracks(f)	U	U

Coefficient of Thermal Expansion(g)

68-212 F = 13.0 x 10^{-6} in./in./F

Density(g) 0.0988 lb/in.^{3}

(a) Data are average of triplicate tests conducted at Battelle under the subject contract unless otherwise indicated. Fatigue, creep, and stress-rupture values are from data curves generated from the results of a greater number of tests.

(b) U, unavailable; NA, not applicable.

(c) Fatigue-cracked single-edge-notched specimen (1 x 2 x 18 inch) tested in bending under four-point loading. No pop-in detected at 300 F.

(d) Double shear (1/4-inch pin).

(e) "R" represents the algebraic ratio of the minimum stress to the maximum stress in one cycle; that is, R = S_{min}/S_{max}. "K_t" represents the Neuber-Peterson theoretical stress-concentration factor.

(f) Alternate immersion, 3-1/2 percent NaCl. 3-point loading bend test.

(g) Values from "Aluminum Alloy 7039", Kaiser Aluminum Brochure (June, 1965).

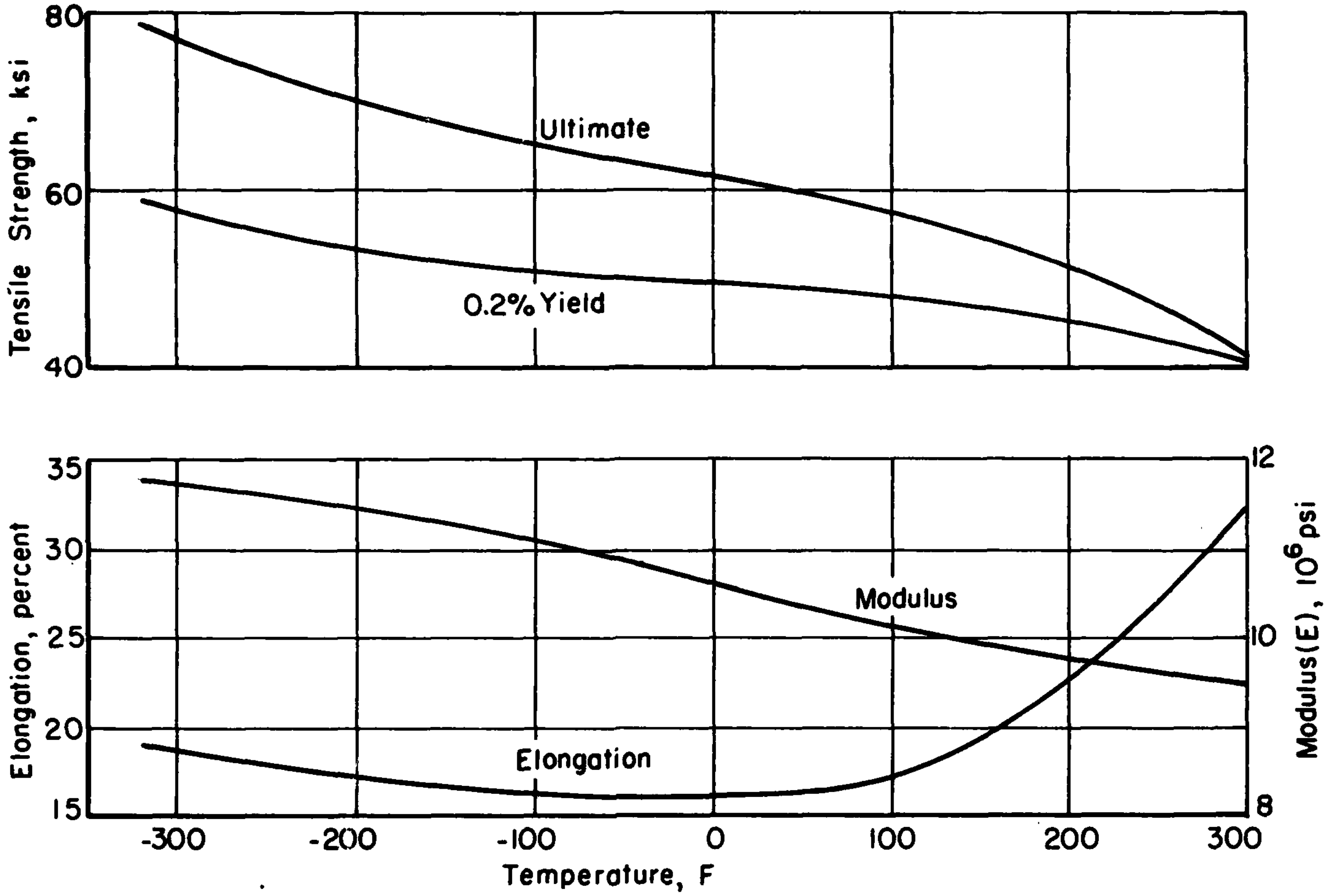

FIGURE 1. EFFECT OF TEMPERATURE ON THE TENSILE PROPERTIES OF 7039-T6151 ALUMINUM ALLOY PLATE

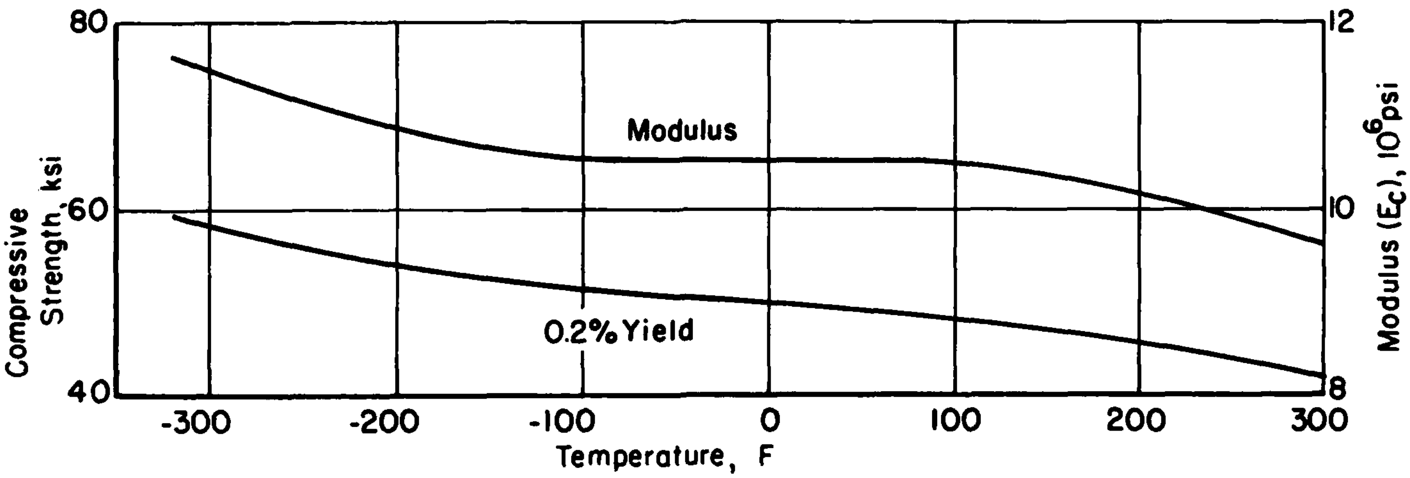

FIGURE 2. EFFECT OF TEMPERATURE ON THE COMPRESSIVE PROPERTIES OF 7039-T6151 ALUMINUM ALLOY PLATE

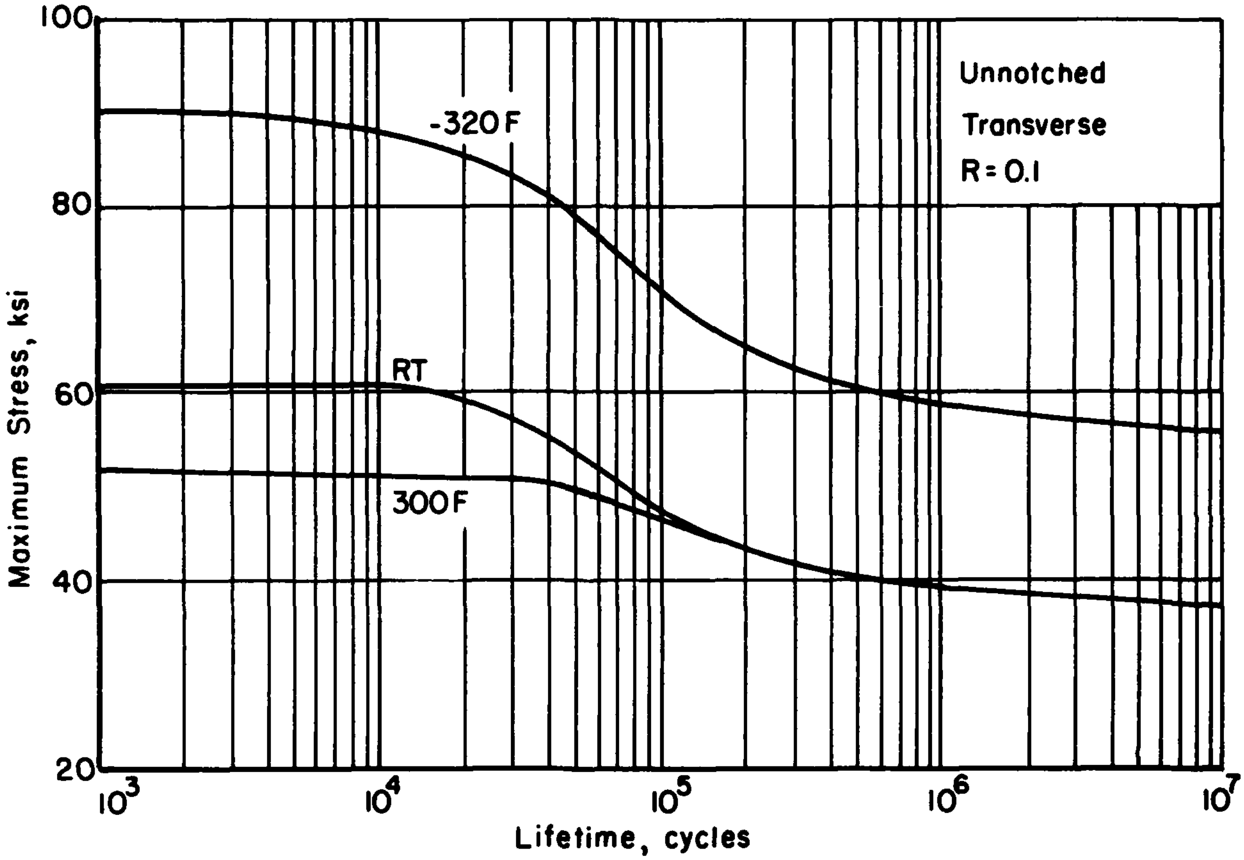

FIGURE 3. AXIAL-LOAD FATIGUE RESULTS FOR 7039-T6151 ALUMINUM ALLOY PLATE

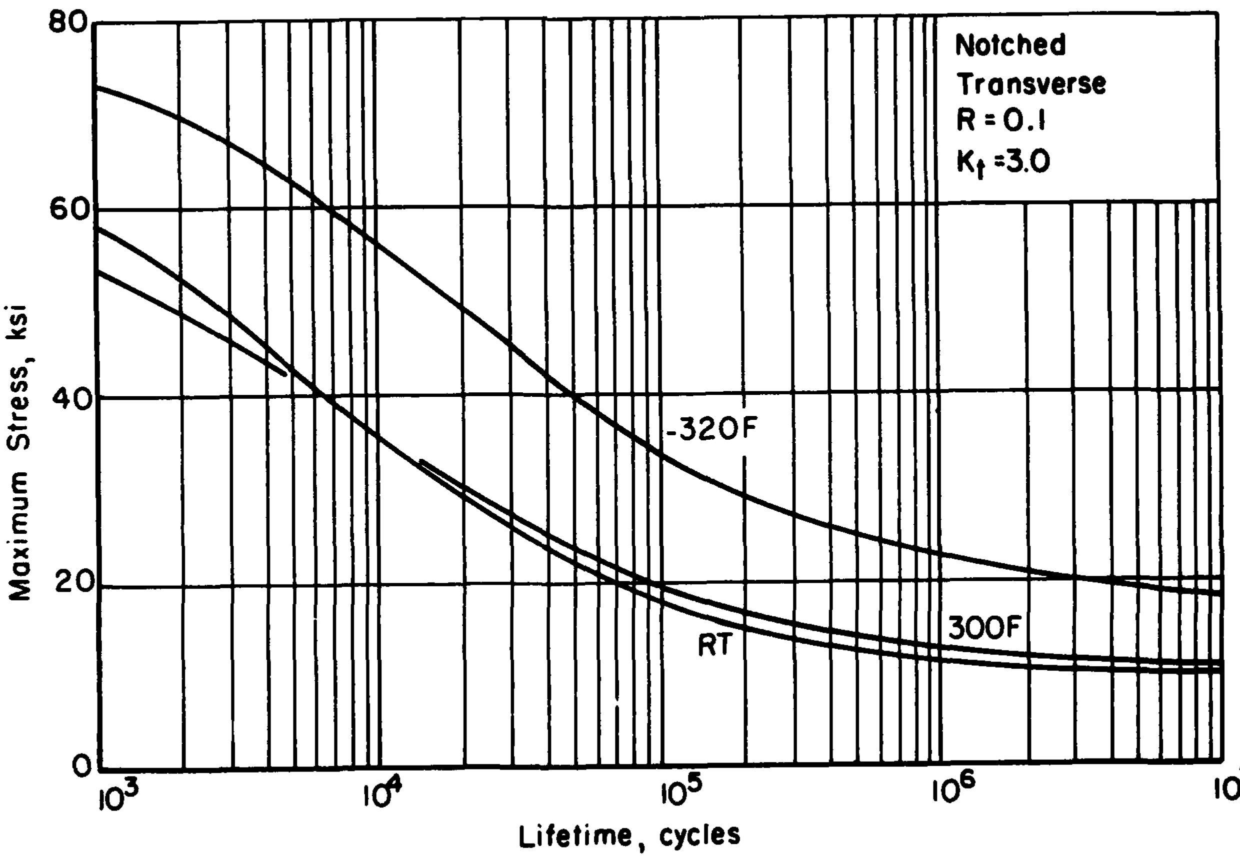

FIGURE 4. AXIAL-LOAD FATIGUE RESULTS FOR NOTCHED (K_t = 3.0) 7039-T6151 ALUMINUM ALLOY PLATE

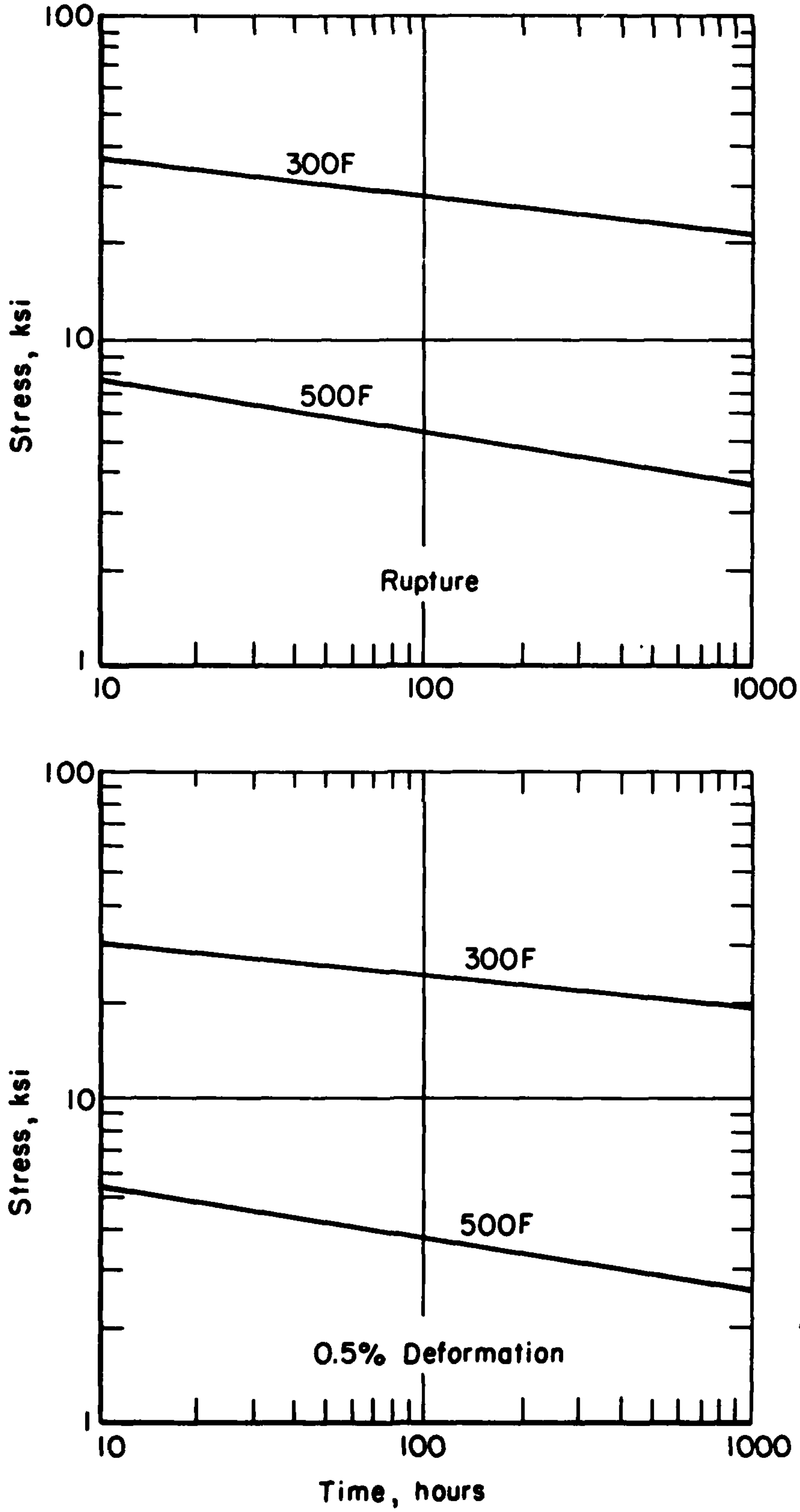

FIGURE 5. STRESS-RUPTURE AND 0.5% DEFORMATION CURVES FOR 7039-T6151 ALUMINUM ALLOY PLATE

REFERENCES

(1) "Aerospace Structural Materials Handbook", ASD TDR 63-741, Vol. II (December 1963), Supplements dated March, 1965, and March, 1966.